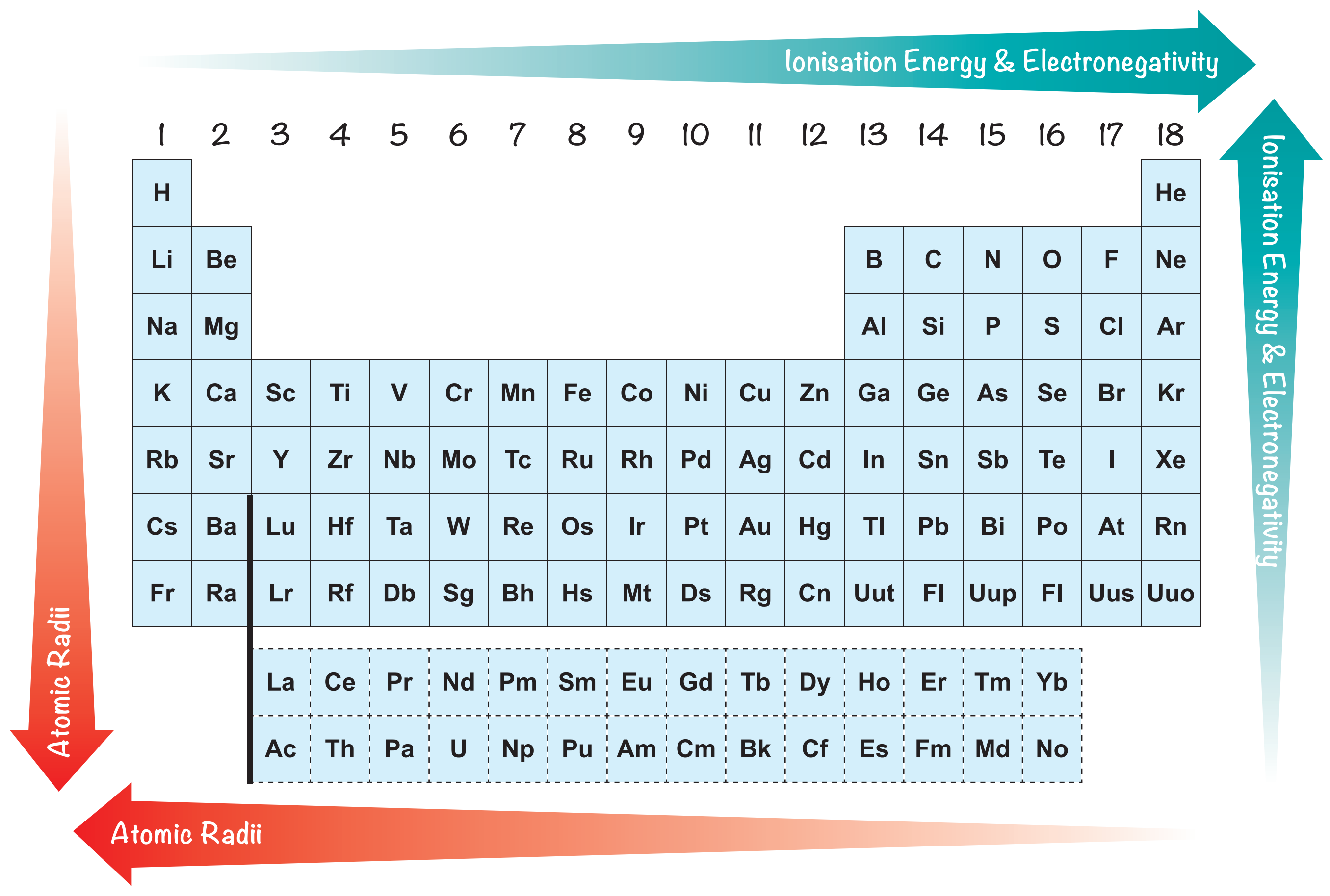
Periodic Table Arrangement and Organisation

Read the following article and use the information to answer the questions in your workbook.



1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
H																	He
Li	Be											B	C	N	O	F	Ne
Na	Mg											Al	Si	P	S	Cl	Ar
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
Cs	Ba	Lu	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
Fr	Ra	Lr	Rf	Db	Sg	Bh	Hs	Mt	Ds	Rg	Cn	Uut	Fl	Uup	Fl	Uus	Uuo
		La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb		
		Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No		

The **Periodic Table** has many patterns as to how it is arranged. The first one is the **Groups** which run down the vertical columns; they are like families because they share similar chemical properties. Their properties are similar because they all have the same electron configuration in their valency (outer) shell.

For example, if we look at Group 1, they have the following electron arrangements:

hydrogen: 1   lithium: 2,1   sodium: 2,8,1   potassium: 2,8,8,1

They all have one electron in their valency shell. This causes them all to behave in very similar ways.

The groups are numbered from 1-18 and all have names, however, only a few of these names are still used today; the others are far less common. Group 1 are the alkali metals, Group 2 the alkali earth metals, Group 11 the coinage metals, Group 12 the volatile metals, Group 17 the halogens and Group 18 the noble gases.

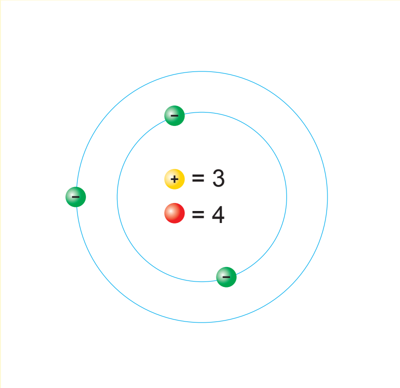
You might have heard of halogen lamps or halogen light bulbs. These use a small amount of bromine or iodine and produce a lot of light even if they are small. They work well at higher temperatures. This makes them really useful in projectors, outdoor floodlights and car headlights.

As you go down the groups from top to bottom, there is an increase in the **atomic radii** of the atoms. This is the size of the atom and is usually the distance from the centre of the nucleus to the outermost electrons.

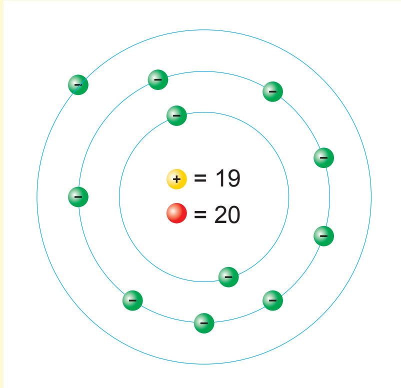
There are also different **Categories** based on their similar physical and chemical properties. For example, the majority of the metals are shiny, conduct electricity and heat, are solid and form alloys (brass is an alloy of copper and zinc and bronze is an alloy of copper and tin) with other metals and salts with non-metals. **Metalloids** have a mixture of metal and non-metal properties. They include the six commonly recognised elements of boron, silicon, germanium, arsenic, antimony and tellurium. There are also five other elements that are sometimes recognised as metalloids: carbon, aluminium, selenium, polonium and astatine. For example, carbon is not shiny or silver, it is quite crumbly (in some forms) but can conduct electricity. The other category is the non-metals which are mostly gases, are either coloured or colourless and have insulating properties. There are always exceptions to these sections and the system is not perfect but the current periodic table of elements is seen as the best fit.

Extension

Also as you go from top to bottom there is a decrease in ionisation energy (the energy needed to remove electrons and become a positive ion). This is because as the atoms get larger in size, the less hold they have on their outer electrons. The closer to the nucleus that electrons are, the better the hold the atom has on them. This is why in Group 1 Francium is extremely reactive. It is large so it has a weak hold on its electrons and has only one electron in its valency shell.



Lithium has a greater hold on its outer electron because it only has two shells. The electron is still close to the nucleus.

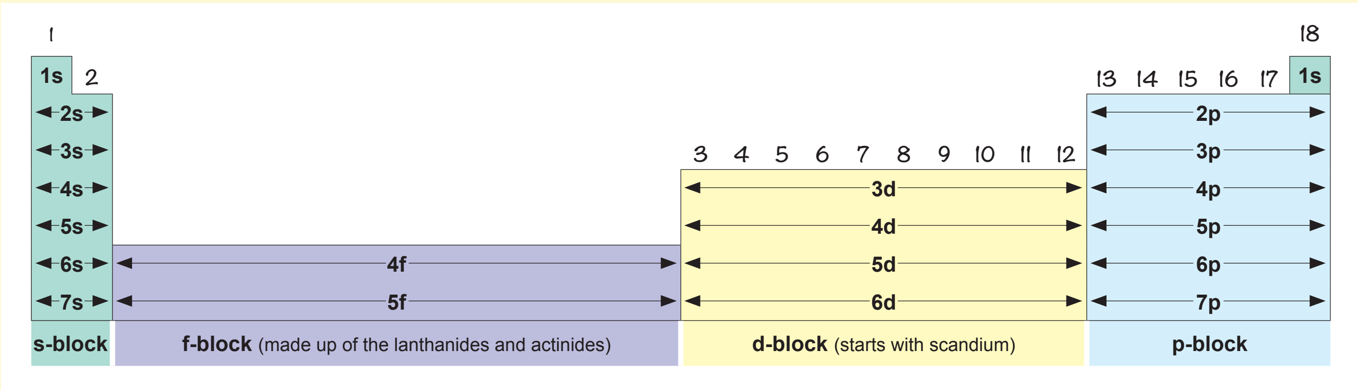


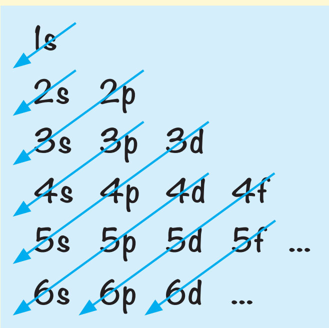
Potassium has a weaker hold in its outer electron because it is farther away from the nucleus. It is much more reactive than lithium.

The **electronegativity** of the atoms also decreases as you go down the groups. This is the atom's ability to attract electrons and become a negative ion. This is also due to the increasing size and less pull from the nucleus on the outer shells.

The second structure are called the **Periods**, which are the rows. These show less trends and patterns than the groups but there are still some. For example, as you go from left to right across a period, the atomic radii decreases (size). This is because there are more protons and neutrons in the nucleus, resulting in more pull on the electrons, bringing them closer in. It is like gravity and planets; the bigger the planet, the more gravitational pull it has so they usually pull in more moons and space junk closer to them.

The **ionisation energy** (energy needed to remove electrons) also increases from left to right because the electrons are more tightly bound to the nucleus. This means that more energy is needed to remove the outer electrons. This links to the electronegativity of the atoms which also increases from left to right, as the bigger ones have more pull so it is easier for them to drag electrons into their orbits.





Another level of organisation are the **Blocks**. The periodic table is divided into four blocks. These blocks are based on the order the electrons fill up the shells. In junior science (and even at Level 1) we work on the principle that each shell can contain 8 electrons (except for the first shell which has 2) and that each shell is filled before electrons are added to the next. In reality, it is a little more complicated than that and there are levels that the electrons fill in a certain order. The **orbitals**, as they are sometime referred to as, are filled in the order shown in the diagram to the left. The first one filled is the 1s which only fits 2 electrons, then the 2s, 2p, 3s, 3p, 4s, and so on. As a general rule, the s-shells fit 2 electrons, the p's 6 and the d's 10.